

CLAIMS

We Claim:

1. A magnetic sensor for use with sense current applied substantially perpendicular to the plane of the layers in the sensor, comprising:

a first antiferromagnetic layer;

a pinned layer comprising an antiparallel pinned

substructure formed on said first

antiferromagnetic layer, said antiparallel pinned

substructure comprising a first ferromagnetic

layer, a nonmagnetic layer formed on said first

ferromagnetic layer, and a second ferromagnetic

layer formed on said nonmagnetic layer, wherein

said first ferromagnetic layer is exchanged

coupled to said first antiferromagnetic layer;

a nonmagnetic separation layer formed on said second

ferromagnetic layer of said antiparallel pinned

substructure;

a ferromagnetic free layer formed on said nonmagnetic

separation layer; and,

a second antiferromagnetic layer supporting magnetic

bias stabilization of said ferromagnetic free

layer.

2. A magnetic sensor as in claim 1 wherein said first and second antiferromagnetic layers are made of the same material having substantially the same blocking temperature.

3. A magnetic sensor as in claim 2 wherein said nonmagnetic separation layer is formed from a conductive material.

4. A magnetic sensor as in claim 2 wherein the nonmagnetic separation layer is formed from an insulating material.

5. A magnetic sensor for use with sense current applied substantially perpendicular to the plane of the layers in the sensor, comprising:

a first antiferromagnetic layer;

a pinned first ferromagnetic layer formed on said first antiferromagnetic layer;

a first nonmagnetic separation layer formed on said pinned first ferromagnetic layer;

a free second ferromagnetic layer formed on said nonmagnetic separation layer;

an antiparallel pinned substructure coupled to said free layer, comprising a third ferromagnetic layer; and,

a second antiferromagnetic layer exchange coupled with said third ferromagnetic layer.

6. A magnetic sensor as in claim 5 wherein said antiparallel pinned substructure is coupled to said free ferromagnetic layer through a second nonmagnetic separation layer.

5 7. A magnetic sensor as in claim 5 wherein said antiparallel pinned substructure is coupled to a portion of said free ferromagnetic layer.

8. A magnetic sensor as in claim 5 wherein said first and second antiferromagnetic layers are made of the same
10 material having substantially the same blocking temperature.

9. A magnetic sensor as in claim 5 wherein said first nonmagnetic separation layer is formed from a conductive material.

10. A magnetic sensor as in claim 5 wherein said first
15 nonmagnetic separation layer is formed from an insulating material.

11. A magnetic sensor for use with sense current applied substantially perpendicular to the plane of the layers in the sensor, comprising:

a first antiferromagnetic layer;
a pinned first ferromagnetic layer formed on said first
antiferromagnetic layer;
a first nonmagnetic separation layer formed on said
5 pinned first ferromagnetic layer;
a free layer formed on said first nonmagnetic
separation layer, said free layer comprising an
antiparallel pinned substructure;
a second nonmagnetic separation layer formed on said
10 free layer, and;
a second antiferromagnetic layer formed on second
nonmagnetic separation layer.

12. A magnetic sensor as in claim 11 wherein said first
nonmagnetic separation layer is formed from a conductive
15 material.

13. A magnetic sensor as in claim 11 wherein said first
nonmagnetic separation layer is formed from an insulating
material.

14. A method of simultaneously initializing two
20 antiferromagnetic layers in a magnetic sensor having an AP
pinned substructure comprising a first ferromagnetic layer,
a first antiferromagnetic layer exchange coupled to said

first ferromagnetic layer and a second antiferromagnetic layer supporting magnetic bias stabilization of the free layer, said magnetic sensor for use with sense current applied substantially perpendicular to the plane of the layers in the sensor, comprising:

placing the sensor in an external magnetic field;
adjusting the magnitude of said magnetic field to cause the magnetization of said first ferromagnetic layer in said AP pinned substructure to be substantially perpendicular to the external magnetic field direction;
heating the sensor above the blocking temperature of both said first and second antiferromagnetic layers; and,
cooling the sensor below the blocking temperature of both the first and second antiferromagnetic layer in the presence of said external magnetic field.

15. A method of simultaneously initializing the antiferromagnetic layers in a magnetic sensor which has a first antiferromagnetic layer exchanged coupled to a pinned layer and a second antiferromagnetic layer exchanged coupled to a ferromagnetic layer, said ferromagnetic layer comprising a portion of an AP pinned substructure supporting magnetic bias stabilization of a free layer, said magnetic

sensor for use with sense current applied substantially perpendicular to the plane of the layers in the sensor, comprising:

placing the sensor in an external magnetic field;

5 adjusting the magnitude of said external magnetic field to cause the magnetization of said ferromagnetic layer in said antiparallel pinned substructure to be substantially perpendicular to the external magnetic field direction;

10 heating the sensor above the blocking temperature of both said first and second antiferromagnetic layers; and,

cooling the sensor below the blocking temperature of both the first and second antiferromagnetic layer
15 in the presence of said external magnetic field.

16. A magnetic storage system, comprising:

a magnetic storage medium for the recording of data;

a motor connected with said magnetic storage medium;

a slider having a magnetic recording head assembly

20 maintained in close proximity to the storage medium during relative motion between said head assembly and said storage medium, said recording head assembly having a magnetic sensor comprising,

a first antiferromagnetic layer;

a pinned layer formed on said first antiferromagnetic layer, wherein said pinned layer comprises an AP pinned substructure;

5 a nonmagnetic separation layer formed on said pinned layer;

a free layer formed on said nonmagnetic separation layer;

a second antiferromagnetic layer supporting bias stabilization of said free layer; and,

10 a suspension connected to said slider which positions said slider for magnetic recording on the disk;

wherein said first and second antiferromagnetic layers are made of the same material having substantially the same composition and having substantially the same blocking temperature.

17. A magnetic storage system as in Claim 16 wherein said nonmagnetic separation layer is formed from a conductive material.

18. A magnetic storage system as in Claim 16 wherein said nonmagnetic separation layer is formed from an insulating material.

19. A magnetic storage system, comprising:

a magnetic storage medium for the recording of data;
a motor connected to said magnetic storage medium;
a slider having a magnetic recording head assembly
maintained in close proximity to the storage
medium during relative motion between said head
assembly and said storage medium, said recording
head assembly having a magnetic sensor comprising,
a first antiferromagnetic layer;
a ferromagnetic pinned layer exchange coupled to said
first antiferromagnetic layer;
a nonmagnetic separation layer formed on said pinned
layer;
a free second ferromagnetic layer formed on said
nonmagnetic separation layer;
one or more bias tabs coupled to a portion of said free
layer, said bias tabs comprising an AP pinned
substructure exchange coupled to a second
antiferromagnetic layer, said bias tabs providing
magnetic bias stabilization of said free layer,
wherein said first and second antiferromagnetic layers
are made of the same material having substantially
the same composition and having substantially the
same blocking temperature; and,
a suspension connected to the slider which positions
said slider for magnetic recording on the disk.

20. A magnetic storage system as in Claim 19 wherein said nonmagnetic separation layer is formed from a conductive material.

21. A magnetic storage system as in Claim 19 wherein said nonmagnetic separation layer is formed from a insulating material.